

[10537/283]

VEHICLE SEATING HAVING A LOWER LEG SUPPORT

FIELD OF THE INVENTION

The present invention relates to a vehicle seat.

BACKGROUND INFORMATION

5 German Published Utility Model No. 92 00 777.5 describes a bus seat with a footrest. The footrest is coupled to the seat cushion of the bus seat via a parallelogram linkage. A pneumatic spring interacts with the parallelogram linkage in order to fold the footrest from a stowaway position arranged  
10 underneath the seat cushion into a position of use.

German Published Patent Application No. 39 10 778 describes a control device for the backrest of a seat. The control device controls an actuator device which adjusts the inclination of  
15 the backrest of a seat. This control device detects an obstacle as the backrest of the seat inclines, it stops the inclination movement of the backrest of the seat.

SUMMARY

20 An example embodiment of the present invention may provide a vehicle seat with an adjustable lower leg support which may have a compact design, may have a comfortable sitting position and may be easy and safe to operate. The vehicle seat may have a high degree of protection against incorrect operation.

25 The lower leg support of the vehicle seat has an automatic drive. A control device with a sensor is connected to the drive in order to control the lower leg support. The sensor is designed to detect an obstacle. As a result, trapping  
30 and/or damage and/or the risk of injury as the lower leg support is automatically adjusted, or when incorrect operation is carried out, is at least partially reduced or entirely prevented.

The drive is designed to adjust the lower leg support automatically, e.g., in an infinitely variable fashion, e.g., in order to displace the lower leg support from a space-saving stowaway position into a position of use and/or from a 5 position of use into the stowaway position. It is also possible to adjust and/or set the sitting position as desired using the drive. The stowaway position is arranged closely against the seat so the vehicle seat may take up as little overall space as possible. The control device may be designed 10 such that it detects the stowaway position of the lower leg support as a zero position, which serves as the reference position for determining the travel of the lower leg support. In the position of use, the lower leg support is pivoted into the foot well and forms a comfortable rest and/or support for 15 the lower legs and/or the feet of the sitting person. The control device calculates the position of the lower leg support in the position of use by the pivoting angle and/or the displacement travel.

20 In an example embodiment, the lower leg support is pivoted by the drive about a pivot axis which extends transversely with respect to the vehicle seat. In addition, the length of the lower leg support may be varied, e.g., the area on which the lower legs rest may be increased by lengthening the lower leg support. During this adjustment process, the lower leg support may strike an obstacle, for example, a piece of 25 luggage or the feet of a sitting person. In order to prevent the obstacle becoming trapped, and/or the lower leg support and/or the obstacle being damaged, the sensor is arranged at 30 the free end of the lower leg support.

The sensor may be arranged as a proximity sensor, e.g., an inductive or capacitive proximity sensor and/or as a pressure sensor, e.g., as a piezoelement and/or switch panel. When an 35 obstacle is struck and/or detected, the sensor transmits a signal to the control device.

In an example embodiment, provision is made for the control device to stop the drive if the sensor detects an obstacle. However, it is also possible for the control device to stop the drive and/or at least partially reverse it in order to 5 prevent the lower leg support and/or the obstacle from being trapped and/or damaged.

The sensor may also be arranged to determine the maximum possible displacement travel of the lower leg support. For 10 this purpose, by actuating the drive, the control device moves the lower leg support out until it arrives at a limit position, i.e., abutting against installations in the vehicle or seats. The sensor detects this limit position so that the control device may detect and/or store the maximum possible 15 adjustment travel of the lower leg support. As a result, e.g., tolerances between the arrangements in the vehicle or installations in the vehicle and the displacement travel and/or the dimensions of the lower leg support may be sensed and compensated for. The sensor detects the set position with 20 the largest possible displacement travel and thus limits the displacement travel in this limit position.

It is possible to use the vehicle seat in passenger cars, buses and watercraft or rail vehicles, etc. The vehicle seat 25 may also be provided as a comfortable passenger seat in aircraft.

According to an example embodiment of the present invention, a vehicle seat includes: an adjustable lower leg support; a 30 drive configured to automatically adjust the lower leg support between a stowaway position and a position of use, and a control device configured to control the drive. The control device includes a sensor arranged on the lower leg support configured to detect an obstacle.

35 The sensor may be configured as at least one of (a) a proximity sensor and (b) a pressure sensor.

The drive may be configured to adjust at least one of (a) a length and (b) an inclination of the lower leg support.

5 The drive may be configured as one of (a) an electrical drive and (b) a pneumatic drive.

The lower leg support may include an enclosed lower leg support surface.

10 The drive may be configured to at least one of (a) increase and (b) decrease the lower leg support surface.

15 The lower leg support may include a freely displaceable end and an end pivotably mounted on one of (a) a seat cushion and (b) a seat frame, and the sensor may be arranged at the freely displaceable end of the lower leg support.

The sensor may include two detection regions.

20 The sensor may include a first detection region arranged on a rear of the lower leg support and a second detection region arranged on an end side of the lower leg support.

25 One of (a) the first detection region and (b) the second detection region may be configured to detect an obstacle when the lower leg support pivots.

30 One of (a) the first detection region and (b) the second detection region may be configured to detect an obstacle when the lower leg support is extended.

35 The sensor may include a bar arranged to cover and connect the first detection region and the second detection region, and the bar may be configured to distribute pressure, that occurs when an obstacle is struck, between the first sensor region and the second sensor region.

The control device may be configured to at least one of (a) stop and (b) reverse the drive in accordance with detection of an obstacle.

5 According to an example embodiment of the present invention, a vehicle seat includes adjustable lower leg support means, drive means for automatically adjusting the lower leg support means between a stowaway position and a position of use, and control means for controlling the drive. The control means  
10 includes sensing means arranged on the lower leg support and for detecting an obstacle.

Further features and example embodiments of the present invention are described below with reference to the appended  
15 Figures. The features and feature combinations which are mentioned above and described below may be used not only in the respectively stated combination but also in other combinations or alone.

20 BRIEF DESCRIPTION OF THE DRAWINGS  
Figure 1 is a view of the vehicle seat with the lower leg support in a position of use.

25 Figure 2 is a cross-sectional view of the lower leg support in a stowaway position.

Figure 3 is a schematic view of the arrangement of the lower leg support.

30 Figure 4 is a cross-sectional view of the sensor.

#### DETAILED DESCRIPTION

Figure 1 illustrates a vehicle seat 1. It has a backrest 11 with headrest 12 and a seat cushion 2 with lower leg support 3. The vehicle seat 1 is displaceably mounted by rails 14 in a vehicle, for example, in the rear of a passenger car. A

seatbelt mount 13 for a three-point belt is integrated into the backrest 11. The backrest 11 and the seat cushion 2 each have an upholstered element with a covering material, for example, leather. The upholstered element 21 upholsters the 5 seat cushion 2 and the lower leg support 3 and is of continuous design. It forms, on its upper side, a coherent, upholstered sitting surface which extends from the seat cushion 2 as far as the lower leg support 3.

10 The lower leg support 3 is extended forward in the position of rest or position of use which is illustrated in Figure 1. It has been pivoted up in the forward direction and extended in order to enlarge its resting surface for the lower legs. The lower leg support 3 has a three-component telescopic component 15 with an upper telescopic element 32, a central telescopic element 33 and a lower telescopic element 34. In order to vary the length of the lower leg support 3, the telescopic elements 32, 33 and 34 may be adjusted in a telescopic fashion by an electric drive 5. A footrest 4 is arranged at the lower 20 end of the lower leg support 3. It is connected to the lower telescopic element 34 and has a footplate 41 which is mounted on a crossmember 42 and which is folded out into the position of use and provides a comfortable support for the feet. The footplate 41 may be pivoted about an axis of rotation which 25 extends transversely with respect to the lower leg support 3, and in the position of use it is approximately perpendicular to the lower leg support 3. One end of the lower leg support 3 is connected to the seat cushion 2. The inclination of the lower leg support 3 in relation to the seat cushion 2 may be 30 set by an inclination adjuster 35 with an electric drive motor. The other end of the lower leg support is freely displaceable and supports the footrest 4. A sensor 6 for detecting obstacles in the displacement path of the lower leg support 3 is arranged at the free end.

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The vehicle seat 1 has both the position of rest or lying position illustrated in Figure 1 and further sitting

positions, e.g., also an upright sitting position with retracted lower leg support 3 and a folded-in footrest 4.

5 The stowaway position with retracted lower leg support 3 and folded-in footrest 4 is illustrated in Figure 2. The telescopic elements 32, 33 and 34 of the lower leg support 3 are pushed one into the other and are arranged pointing approximately vertically downwardly at the front end of the seat cushion 2. An inclination adjuster 35, which connects 10 the lower leg support 3 to the seat cushion 2, is arranged on the upper telescopic element 32. The inclination adjuster 35 has an electric motor for adjusting the inclination of the lower leg support 3.

15 The footplate 41 is arranged in parallel with the lower leg support 3 and forms, together with the seat upholstered element 21, a planar front surface which closes off the vehicle seat from the front. The rear of the footplate 41 is flush with the upper side of the seat upholstered element 21 20 so that the vehicle seat does not have any protruding edges and/or the footplate 41 may not be inadvertently folded forward. In the stowaway position, the lower leg support 3 and the footrest 4 are arranged resting against the front region of the seat cushion 2. This stowaway position may save 25 space and may not adversely affect the amount of foot space available in the vehicle.

The sensor 6 is arranged at the lower end of the lower leg support 3 and has two sensor surfaces 61, 62. The first 30 sensor surface is arranged on the end side of the lower leg support 3 and is arranged to detect obstacles which are in its displacement path when the lower leg support 3 extends in a linear fashion. The second sensor surface 62 is arranged at the rear of the lower leg support 3, i.e., on the side facing 35 away from the lower leg support surface. It is arranged to detect obstacles which are in the displacement path when the lower leg support 3 is pivoted.

Figure 3 illustrates the schematic design of lower leg support 3 with drive 5. The drive 5 is arranged as a spindle drive and has an electric drive motor 51 which drives a first spindle drive 56 and a second spindle drive 57. The drive 5 is connected via a bridge to the central telescopic element 33. The first spindle drive 56 engages between the central telescopic element 33 and the upper telescopic element 32, and the second spindle drive 57 engages between the central telescopic element 33 and the lower telescopic element 34. The upper telescopic element 32 and the lower telescopic element 34 are moved synchronously away from the central telescopic element 33 or toward the central telescopic element 33 via the spindle drive 56, 57.

The electric drive motor 51 drives the first spindle drive 56 and the second spindle drive 57 in opposite directions by a gear mechanism. As a result, the electric motor 51 drives the telescopic elements 32, 33, 34 such that, in one sense of rotation, the upper telescopic element 32 and the lower telescopic element 34 are driven away from the central telescopic element 33, and in the opposite sense of rotation, the upper telescopic element 32 and the lower telescopic element 34 are driven toward the central telescopic element 33.

The drive motor 51 is connected to a control device 52. The control device 52 controls the drive motor 51 and/or the inclination adjuster 35 and thus the movement sequence of the lower leg support 3. The control device 51 is connected to the sensor 6 in order to detect obstacles, the sensor 6 being arranged at the lower end of the lower leg support 3. The control device 52 is connected via cables to the sensor 6 and in addition to the drive motor 51 and the inclination adjuster 35. In addition, the control device 52 has a power feed line. A cable guide 53 which is connected to the central telescopic element 33 prevents the cables becoming entangled and/or damaged when the lower leg support 3 moves. The cable guide

53 has a spring-loaded cable drum which automatically retracts or unrolls the guided cables. The cable guide 53 therefore takes up the cable slack and keeps the cables taut so that the cables are prevented from becoming entangled and/or flapping around.

If the sensor 6 detects an obstacle, it transmits a signal to the control device 62. The latter then stops the movement of the lower leg support 3 and moves it back a certain amount in 10 order to prevent the obstacle from becoming trapped and/or being damaged.

Figure 4 illustrates the sensor 6. It is arranged on the crossmember 42 of the lower telescopic element 34. A first 15 sensor surface 61 is arranged on the end surface and a second sensor surface 62 is arranged at the rear of the crossmember 42. The sensor surfaces 61, 62 extend over a large part of the width of the lower leg support 3 and are arranged as pressure-sensitive switch panels.

20 The sensor 6 has an electrically conductive contact film 65 which is connected in a planar fashion to the crossmember 42 via an insulator 64. An electrically conductive connecting strip 66 is arranged over foam inlays 67 which are arranged as 25 spacing elements and are at a distance from the contact strip 65. If pressure is exerted on the connecting strip 66, the foam inlay 67 is pushed over and the connecting strip 66 moves into electrically conductive contact with the contact strip 65.

30 An elastic rubber strip 63 covers the first switching surface 61 and the second switching surface 62. The rubber strip 63 is clipped to the crossmember 42 and secures the sensor 6 so that it rests directly on the crossmember 42. The rubber strip is connected to the sensor 6 so that, in order to 35 replace the sensor 6, only the rubber strip 63 with sensor 6 has to be replaced.

The elasticity of the rubber strip 63 may be dimensioned such that, when there is contact with an obstacle, it distributes the pressure which occurs between the first sensor surface 61 and the second sensor surface 62. As a result, the obstacle 5 may be reliably detected even if the obstacle does not directly strike the first sensor surface 61 or the second sensor surface 62.

In the stowaway position, the sensor 6 abuts against the 10 vehicle seat 1. As a result, the sensor 6 detects the home position of the lower leg support 3. The home position thus serves as a reference position for the control device 52, from which position it determines the position of the lower leg support over the displacement travel. In order to compensate 15 for tolerances, the control device may determine the limit position of the lower leg support 3 by moving out the lower leg support to a maximum extent until the lower leg support moves into contact with installations in the vehicle, and the sensor 6 signals the limit position. The sensor 6 detects the 20 maximum possible displacement position and thus limits the maximum possible displacement travel of the lower leg support 3.

ABSTRACT

A vehicle seat includes an automatically displaceable lower leg support. The lower leg support may be displaced in an automatically driven fashion between a stowaway position and a 5 position of use. In order to obtain a compact design of the vehicle seat and a high degree of protection against impact operation, the lower leg support has a sensor which is connected to a control device of the drive. The sensor is arranged to detect an obstacle.